Concept for Frequency Multiplexing Prism Capable of Supporting Temporally Synchronized “Flash” LiDAR

?? April 2008
Simon Edwards
Research Acceleration Initiative

Introduction

LiDAR technology has traditionally consisted of the use of a single beam which must “scan and sweep” in order to create a single three-dimensional map of a surface being measured. This is extremely limiting given that it takes, depending upon the size and application of the scanning/sweeping mechanism, anywhere from a quarter-second to multiple minutes to create a single snapshot of an area to be measured.

Although useful, LiDAR as it has previously existed is incapable of supporting many applications which might become feasible with the advent of an improved method for Light Detection and Ranging.

Abstract

LiDAR, which is predicated upon time-of-flight analysis, may be substantially improved through the use of a prism which is designed to convert single-mode light into a nearly endless variety of frequencies. The prism would be designed to accept light of a specific frequency and to modify the frequency of the light using magnetically active prism materials so that the greater the thickness of material through which light passes, the more the frequency of the light is altered.

Each prism would be designed so that no two areas of the prism would have the same thickness, thus ensuring that light of a given frequency would never be emitted in more than a single direction. Each frequency of light generated would correspond to a specific point in the field of view of the light emitting mechanism. Time-of-flight for each specific frequency would be computed with the assistance of a sensor capable of distinguishing between multiple, subtly different frequencies arriving at near the same instant in order to assess range in a manner which allows for the rapid generation of a temporally-synchronized, high-resolution, three-dimensional map of an environment.

The prism, itself would consist of a series of layers each of which modify the frequency of light by a given, proportional value.

Spiroform machining would be used to ablate the prism by moving the prism while it sits upon a pedestal relative to a stationary cutting tool. A minimal or zero thickness of prism would ablated from the center of the prism and an increasing thickness of prism would be ablated progressively as the wobble of the prism on its pedestal allows for a path of reduced thickness to be created in a spiral pattern over the surface of the prism. This process ensures that no two areas of the prism are of the same thickness and therefore, by dint of the

same fact, ensures that no single frequency of light is emitted redundantly in more than one direction of travel.

Conclusion

Such a mechanism would enable temporally-synchronized, three-dimensional maps of unprecedented resolution to be created in support of a variety of applications.